15 January 1965

Gentlemen:

We have reviewed your requirements for an image panel for reproduction of back projection transparencies. Unfortunately, we find the requirements for unity gamma, high light brightness, panel size and resolution are at present beyond any state-of-the-art.

Present solid state image converter panels consist of contiguous layers of a light sensitive photoconductor and a light emitting electroluminescent phosphor layer separated by an opaque barrier. Certain modifications may also be present in the form of imbedded fine wires in the photoconductor to allow image polarity control and special light reflecting TiO_2 layers to enhance output brightness. Grooving of the photoconductor to achieve high sensitivity has also proved effective. In any case, the resolution is limited now at about forty lines per inch for the grooved type and about twice this for the parallel wire version of Sasaki, et al. These numbers fall short of your requirements for an image panel. The basic phenomena of electroluminescence in present usage (Destriau effect) as a controlled light source is quite inefficient so that high output brightnesses are difficult to achieve. A nominal level of 10 ft. lamberts is reasonable for present panel high light brightness and this is rather low for your requirements.

System gamma is variable with SSIC's and is a function of practically every operating parameter plus material preparation. Gamma can be made equal to unity over limited input ranges with certain known techniques.

Our own research in the field of Image Intensifier Screens has led us to the development of a new concept employing photoconductor-electroluminescent materials. In this development a mosaic of intagliated fiber optics is used. Each fiber has a wire through its center to connect the photoconductor to the

electroluminescent layer. The resolution is a function of the individual cell sizes. At present, resolutions of approximately 250 lines per inch appear feasible although 125 lines per inch is easier to attain. The responsivity is high and the luminous gain is of the order of 10^3. System linearity is good and the gamma can be controlled if desired. However, since the Destriau effect is used in the electroluminescent material the ten foot lambert upper limit for brightness is a limiting factor unless ultra-thin film techniques are used. Total panel size, output brightness and cell response uniformity are still the major problems. One-inch square units are presently possible. Larger panels may be obtained by stacking but as yet we have not attempted to do this.

A solid state image converter screen which appears possible but which has not yet been demonstrated in the sizes desired for this application makes use of the channel multiplier devices developed by the [redacted] This material is a special ceramic which acts as an electron multiplier. Electron gains on the order of 10^4 to 10^6 can be attained with these multipliers and resolution on the order of 20 lines per millimeter have been obtained. The manner in which this material would be used in an image converter screen is as follows: A cesium photoemissive material would be coated on a transparent plate. The channel multiplier would be placed immediately behind this cesium electron emitter in vacuum and a voltage would be applied across the multiplier. A cathodoluminescent screen would then be placed close to the output end of the channel multipliers so that the electrons emitted by the multiplier strike the screen and produce a bright spot. By accelerating the electrons between the multiplier channels and the screen (and maintaining a focusing field) output brightness greater than 10 foot lamberts might be obtained. With these devices the individual cell sizes limit the resolution at present to approximately 20 lines per millimeter. The maximum size of the total panel known to date is approximately ½ inch diameter.

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[redacted] is presently working on techniques for using photoconductors to control the electron emission or otherwise to provide a means of controlling a light emitter. These techniques again depend on a mosaic structure for light control. Present state-of-the-art is such that the 250 lines per inch resolution appears to be a potential upper limit. A photoconductor-controlled electron emitter could work into a channel multiplier or other accelerating and focusing system to provide a bright spot on a phosphorescent screen. The screen size desired in the technical exhibit appears to be far beyond present capabilities.

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[redacted] is also working in the area of thin film electroluminescent layers but at present no success or maximum output brightnesses can be predicted for your application.

Should you be interested in pursuing the problems of image intensification with regard to image intensifier screens of a more modest capability than in the request, yet better than of the grooved types, we would be pleased to discuss our approach and propose advanced work for you. We are anxious to continue and to increase our efforts along the lines indicated; and if you are interested in the work we have already done on the problem, we can make it available for your personal. Please feel free to call upon us for further information.

Very Truly Yours,

[redacted]

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CPB:fm